A STRUCTURAL MODEL FOR MITIGATION MEASURES OF CRITICAL COST OVERRUN FACTORS IN HIGHWAY PROJECTS IN SINDH PROVINCE

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DEDICATION

For my Beloved Parents and Teachers for their prayers and support. For my beloved wife (Shahnila), my daughter (Aamina) and my son (Muhammed Hassan) who supported me in all endeavors.

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ABSTRACT

Construction industry plays a major role in improving the socio-economic growth of any country. However, this industry is facing a serious problem of cost overrun globally and particular in Pakistan. Rapid growth in the construction sector in Pakistan has been observed along with many challenges, especially in highway projects. The most critical issues in highway projects are the cost overrun and lack of their mitigation measures. Hence, the objective of this research is to determine the critical factors of cost overrun, its significant mitigation measures and to develop a structural model of significant mitigation measures for critical cost overrun factors. The preliminary survey helped in identifying the critical factors of cost overrun in highway projects. In total, 64 common factors for cost overrun were identified from the literature review. Based on the common factors, a questionnaire was designed and distributed among the 30 selected experts to determine the critical factors of cost overrun. Out of 64 common factors, 24 were reported critical. The pilot study was carried out by developing a semi-structured questionnaire which was distributed among the same 30 construction experts for the purpose of determining the mitigation measures, which resulted in 113 measures. These mitigation measures along with the relevant 24 factors helped in the development of the final questionnaire to further narrow down the significant measures. This finalized questionnaire was distributed among 350 construction experts of highway projects to identify the significant mitigation measures for critical factors of cost overrun. The collected data was further used to develop a structural model for mitigation measures of critical factors of cost overrun by Smart PLS. Performance of the model has moderate explaining power as the predictive relevancy value is greater than 0.13. Significant mitigation measures of these critical factors were determined from the power loading of mitigations measures. This research would be helpful for construction managers in mitigating the relative risk to the project. Thus, it will directly benefit the construction community and contribute in raising the economy of the country.

ABSTRAK

Industri pembinaan memainkan peranan utama dalam meningkatkan pertumbuhan ekonomi sesebuah negara. Namun, ia mewujudkan masalah yang serius seperti lebihan kos, yang berlaku di seluruh dunia termasuk Pakistan. Pertumbuhan pesat dalam sektor pembinaan di Pakistan mempunyai pelbagai cabaran terutama dalam projek lebuh raya. Isu yang paling mencabar dalam projek lebuh raya adalah lebihan kos dan tiadanya langkah-langkah pencegahan. Oleh itu, objektif penyelidikan ini adalah untuk mengenal pasti faktor-faktor lebihan kos, langkah-langkah pencegahannya seterusnya membangunkan model struktur langkah-langkah kawalan yang kritikal. Kajian awalan membantu mengenal pasti faktor-faktor kritikal kos lebihan dalam projek-projek lebuh raya. Sejumlah 64 faktor lebihan kos telah dikenalpasti daripada kajian literatur. Berdasarkan faktor-faktor tersebut, soal selidik telah direka dan diedarkan kepada 30 responden untuk meneliti faktor-faktor signifikan. Daripada 64 faktor, 24 dilaporkan kritikal. Kajian rintis dijalankan melalui soal selidik separa berstruktur yang diagihkan kepada 30 pakar pembinaan dengan tujuan untuk mencari langkah-langkah pencegahan dan 113 langkah telah terhasil. Langkah-langkah pencegahan ini disertakan dengan 24 faktor yang berkaitan bagi membantu dalam menjalankan soal selidik akhir. Soal selidik ini telah diedarkan kepada 350 pakar pembinaan yang terlibat dalam projek lebuh raya untuk mengenalpasti langkah pencegahan terhadap faktor lebihan kos yang kritikal. Seterusnya, data yang terkumpul digunakan untuk mewujudkan model struktur bagi mengenalpasti langkah-langkah pencegahan kos lebihan menggunakan perisian Smart PLS. Prestasi model ini mempunyai kuasa penjelasan yang sederhana dengan nilai perkaitan ramalan lebih besar daripada 0.13. Langkah-langkah pencegahan kepada faktor-faktor kritikal ini dikenalpasti daripada kuasa muatan langkah pencegahan. Kajian ini akan membantu pengurus pembinaan dalam mengurangkan risiko berkaitan lebihan kos kepada projek. Oleh itu, ia secara langsung akan memberi faedah kepada komuniti pembinaan dan meningkatkan ekonomi negara.

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LIST OF ABBREVIATIONS

N	-	Number of Items
$\bar{r}$	-	Average inter-correlation among items
G.D.P	-	Gross Domestic Product
U.K	-	United of Kingdom
S.P.S.S	-	Statistical Package for Social Science
PLS-SEM	-	Partial Least Square Structural Equation Modeling
Csv	-	Comma Separated Value
AVE	-	Average Variance Extracted
CR	-	Composite Reliability
Q2	-	Predictive Relevancy
CV Red	-	Cross Validated Redundancy
CV Com	-	Cross Validated Community
PKR	-	Pakistan Rupees
f2	-	Effects Size
R2	-	Explanatory Power

CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction industry plays an important role in the economic development and modernization of a country. The construction industry is considered as major source of economic growth of any country. The construction industry also improves the quality standard of life by construction of infrastructures such as roads, schools, hospitals and other infrastructures (Al-Emad & Hamid, 2016). Hence, it is fundamentally critical to complete the construction projects within the cost, time and quality parameters. However, the construction industry is a complex nature, fragmented and schedule driven industry, therefore, it is facing a critical problem of cost overrun, low quality, time overrun, construction waste and low productivity etc. Out of the problems faced by construction industry, cost overrun is a major problem as money is always of high importance (Mahamid & Dmaidi, 2013).

The output from the construction industry is a major and integral part of the national output, accounting for a sizeable proportion in the Gross Domestic Product (GDP) of both developed and underdeveloped countries (Jones, 2014). Cost overrun in the construction industry is a universal and regular phenomenon, where only a few projects are completed within the estimated budget (Aljohani, Dagbui & Moore, 2017; Ali & Kamaruzzaman, 2010).

Cost overrun in the construction industry is a problem which causes serious issues in both developing as well as developed countries, though it has more severe impact in developing countries where cost overrun can go beyond 100% of the estimated cost of the project (Vaardini, Karthiyayini & Ezhilmathi, 2016). In addition

to this, it is believed that the construction projects experience an increase in the cost of about 33% on average (Hartley, 2017).

According to Senouci, Ismail & Eldin (2016), 66 construction projects out of 122, faced cost overrun related issues in construction projects of Qatar. A recent study carried out by Yongjian *et al*., (2013) on the construction projects of Singapore concluded that 60% of projects were affected due to cost overrun. In Jordan, 65% of the construction projects were affected by cost overrun (Sweis, 2013).

Cost overrun is serious and critical issue which badly effects the economy of the Norwegian where cost overrun has faced more than 60% from the approved cost of the projects. Construction of highway projects have faced more cost overrun as compared to other construction projects (Welde & Odeck, 2017). Cost overrun is the main problem in construction projects, as cost is the one of the major concern throughout the project management lifecycle and it can be considered as the driving force for the project success (Aziz, 2013).

Government of Pakistan is not giving importance to construction industry as compared to other industries, although Pakistan's construction industry contributes greatly toward the GDP and employs about 9% of the total labor force (Farooqui, 2008). Though contributing to 2.405% of total GDP, the construction industry of Pakistan suffers badly due to cost overruns (Keerio *et al*., 2017). Therefore, it has become imperative to investigate in detail of mitigation measures and most significant mitigation measures for causative factors of cost overrun in highway.

1.2 Problem statement

Employing approximately 2.3 million people and contributing 12% to the overall economic growth, transport is the fourth largest sector in Pakistan (Farooque & Wasti, 2015). According to the report issued by Ministry of Finance (2015), with the deteriorating performance of the Pakistan Railways, the reliance on highways in Pakistan has increased manifolds and now the highways sector carries over 96% of inland freight and 92% of passenger traffic.

Like other developing countries, Pakistan's construction industry is also facing critical issue of cost overrun (Azhar *et al*., 2008; Nasir *et al*., 2011; Chouhadary *et al*., 2012; Ejaz *et al*., 2013; Nawaz *et al*., 2013; Zafar *et al*., 2016 & Keerio *et al*., 2017).

According to Azhar *et al*., (2008), almost every project undertaken in construction industry of Pakistan experiences cost overrun with range of at least 10% of the estimated cost. According to Nawaz *et al.,* (2013), 90% of projects of Pakistan's construction industry are facing the problem of cost overrun. For Example, International airport of Islamabad has faced cost overrun more than 250% from actual cost (Amer, 2015). It has been reported by Khan (2016), that the construction projects in Sindh province of Pakistan, has been affected by cost overrun. Though cost overrun is prevalent in all types of construction projects however, it is more chronic in highway projects compared to other types of construction projects in Pakistan (Keerio *et al*., 2017). The highway projects constructed in Sindh have faced more than 100% of cost overrun which adversely impact the economy of Pakistan (Tahir, 2018). It has been reported that highway projects in Sindh province are facing serious issue of cost overrun as compared to other provinces of Pakistan and this cost overrun has affected the GDP of Pakistan (Sajjad, 2018; Keerio *et al*., 2017).

There are various factors which lead to cost overrun in highway projects. The issue of cost overrun in highway projects can be minimized by determining mitigation for critical cost overrun factors. According to Keerio *et al*., (2017), there is a need to conduct research work and study on the mitigation measures for cost overrun factors of highway projects in Sindh, Pakistan.

Hence, this research focuses on determining the mitigation measures for critical factors of cost overrun and developing a structural model in representing the significant mitigation measures of overrun for highway projects of Sindh province of Pakistan.

1.3 Research questions

Based on above highlighted problem statement, the following research questions have been formulated for this study:

1. What are the critical factors of cost overrun in highway projects of Sindh province of Pakistan?
2. What are the possible mitigation measures in highway projects of Sindh province?

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